



**REPORT ON THE ENVIRONMENTAL
CLEANUP AND RECOVERY OF
DERELICT BARRELS FROM WATSON LAKE,
YUKON TERRITORY**

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Prepared for:

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AND NORTHERN DEVELOPMENT**
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Whitehorse, Yukon Territory

SUMMARY

As part of the Arctic Environmental Strategy (AES) of renewing and protecting the integrity of the environment, this project was carried out in order to recover derelict "forty-five gallon" drums (barrels) from Watson Lake, Yukon Territory.

The recovery of the barrels was broken down into two groups based on the recovery methods employed. One group of 130 barrels was recovered just offshore from the B.C. Forest Service's Initial Attack Base (for fighting forest fires) and the second group was made up of 84 barrels distributed around the lakeshore (Lakeshore Barrels). All the barrels were holed as a result of mechanical or corrosion damage and, for the most part, contained lake water. A number of the barrels, in particular the 130 barrels located at the Initial Attack Base, contained residues of a tar-like substance. In addition, two barrels were recovered that had motor oil and diesel fuel residues respectively.

The condition, position and distribution of the barrels located at the Initial Attack Base indicate that the majority of these barrels were deposited into the lake at the same time. The variability in the condition of those barrels located around the lakeshore indicate that they were dropped into the lake over the years. Many of the lakeshore barrels were filled with rocks or sand and were used to support docks at some point in the past.

During the recovery process, barrels were identified that were not listed in the 1991 Fraser Burrard Diving Ltd. (FBD) survey, on which the inventory of this recovery project was based. As a result of these observations, Foreshore Technologies Inc. (FTI) personnel conducted a cursory visual survey of 70% of the lake's shoreline from a boat. This survey identified 142 extra barrels not listed in the 1991 FBD survey.

Although recovery of these extra barrels was not part of the project, 11 barrels were recovered from around the lakeshore in order to make up for a short fall in the number of barrels that were expected to be retrieved from the Initial Attack Base site. The shortfall was the result of Watson Lake residents having recovered some of the barrels from the lake prior to the commencement of this project.

The presence of a significant number of extra barrels located around the lakeshore, the variances between the FBD stated longitude and latitude of debris and their actual position, and, the lack of any debris in water depths greater than 4.6 metres (15 feet) raise concerns about the thoroughness and reliability of the 1991 FBD survey. This in turn raises the questions as to how much and what type of debris still remains in Watson Lake. If a complete clean-up of Watson Lake is to be assured, then further debris surveying with appropriate technology and methods will have to be performed.

The success of this project serves as an example of how government and private industry can work together to expand local expertise and economic opportunities through the protection and recovery of arctic environments.

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INTRODUCTION

In response to the threat of a Japanese invasion of Alaska during the Second World War, the Canadian and primarily American governments began construction of a series of military airports in order to supply Alaska with troops and materials. In 1941, Watson Lake was chosen as a site for one of these military airports. A year later, Watson Lake became a major supply depot for the construction of the Alaska Highway.

These two construction projects, along with Watson Lake's location in the southeast Yukon, near the British Columbia border, has led to its' development as an important distribution centre for tourism, mining and logging. However, the development of Watson Lake has not been without environmental impacts. One of these impacts is the accidental or deliberate dumping of debris into Watson Lake.

The presence of this debris in the lake raised concerns among local residents and government environmental agencies as to the potential environmental threat it might represent. As a result, a number of preliminary surveys of the lake were conducted.

In 1990, an investigation into the Watson Lake trout fishery identified DDT as a major contaminant. Its' presence was attributed to the common use of the pesticide to suppress mosquitoes in the area during the 1950s and 1960s. Other surveys revealed the presence of military ordnance, and although salvage operations by the Department of National Defense (DND) in the 1970s removed all the identified ordnance, there is the possibility that undetected ordnance still remains in the lake.

Under the Arctic Environmental Strategy (AES) a detailed survey of the lake bottom using side scan sonar was conducted by Fraser Burrard Diving Ltd. (FBD) in October 1991. That survey identified approximately 220 "forty-five gallon" drums (barrels), a tail section of an aircraft and two sunken boats. All the debris identified by the 1991 FBD survey was in less than 4.6 metres (15 feet) of water and was visible from the surface. No debris was found in the deeper sections of the lake.

This project, also under the AES, involved providing professional recovery services to the Department of Indian Affairs and Northern Development (DIAND) with respect to the cleanup and recovery of the barrels identified in the 1991 FBD survey of Watson Lake.

PROJECT TEAM

Foreshore Technologies Incorporated (FTI) is a British Columbia based, 100% Canadian-owned company specializing in professional and technical services in the marine and freshwater environments. These services include underwater and above-water structural inspections, environmental impact assessments, in-water environmental protection systems, underwater physical

and biological mapping, and, specialized recovery procedures. Although FTI maintains its' offices and centre of operations in North Vancouver, its' work experience includes the Maritimes, Alaska, the Territories and several international projects.

Many of FTI's projects require close contact with a number of government agencies with regard to the environment, and in particular, we have performed projects in which contact with DFO Habitat Management, Environment Canada - Ocean Dumping / Contaminants Division / Canadian Wildlife Service, B.C. Environment - Fish & Wildlife / Waste Management and Coast Guard - Navigable Waters Protection Act (NWP) were required.

Over the past ten years, FTI has established an experienced team of professional and technical personnel who have specific salvage and environmental work experience including spill containment, deleterious substance control and military ordnance identification. FTI's approach of providing practical and technical solutions to meet its' clients' needs has earned FTI a solid reputation in the freshwater/marine engineering and environmental sciences community.

During the development of the Watson Lake barrel recovery proposal, it was decided that the project and FTI could benefit from the involvement of local residents and businesses. Specifically, local knowledge of the weather, lake conditions and alternate sources of equipment and manpower were key components in reducing the number of project contingencies. In turn, this allowed for the development of a site specific strategy for the safe and efficient recovery of the barrels.

SITE DESCRIPTION

Watson Lake is located in the southeastern portion of the Yukon Territory near the northern border of British Columbia. The community of Watson Lake is located 12 km south of the lake and 450 km southeast of Whitehorse, on the Alaska Highway, see the location map provided on Drawing No. 2.

The lake runs roughly in an east-west direction and is 8.5 km long and 2.75 km wide at its' greatest dimensions. In addition to a shallow shoreline, the lake contains a number of shoals and an island. The deepest section of the lake is reported to be 41.5 m with the lake bottom primarily made up of a fine silt.

The Watson Lake Airport and the B.C. Forest Service's Initial Attack Base (for fighting forest fires) are located along the north shore of the lake. In addition, a number of cottages and permanent residences can be found along the northeastern shore, see Photograph No. 1.

SUMMARY OF THE 1991 FBD SURVEY

The 1991 FBD survey identified a large concentration of barrels (150+) just offshore from the Initial Attack Base. An additional 73 barrels and two derelict boats were located along the northern and eastern shores of the lake, and, a derelict tail section of a plane was found on the western shore, see Drawing No. 1. The 1991 FBD survey found no barrels along the western and

southern shores or in greater than 15 feet (4.6 m) of water depth. In the survey report, barrel locations were presented as longitude and latitude fixes using a Magellan NAV 1000 Plus Satellite Navigation System or Global Positioning System (GPS). In addition, a map was provided showing the barrels relative position in the lake, see Drawing No. 1.

Apart from the 150+ barrels located at the Initial Attack Base, the barrels were found in groups of less than 12. These smaller groups, it was speculated in the FBD survey, were used to build recreational floats or docks while the barrels located at the Initial Attack Base appeared to be some form of deliberate dump. As no markings could be found on the barrels describing their contents and there was the potential of unrecovered military ordnance, the barrels were left undisturbed by the FBD divers.

PROJECT METHODOLOGY

General Approach

Of paramount importance during the project was the prevention of a contaminants release into the environment and the completion of the project before the ice cover period. It was on this basis that the following procedures for the Watson Lake cleanup were developed and carried out.

The methods described below are those that were actually performed during the recovery. They vary somewhat from those outlined in the FTI proposal as there was a significant reduction in the risk of a contaminant release once the condition of the barrels and their contents were identified. However, it is important to note that the procedures and equipment (Appendix I) described in the proposal to handle a higher risk scenario were in place and ready to be initiated throughout the course of the project.

Barrel Identification & Location

The initial task set for the FTI project team was to relocate the barrels identified in the 1991 FBD survey. Test plots of the plane tail section and the 150+ barrel site using the longitude and latitude positions provided in the 1991 FBD survey revealed significant variances between the actual and reported locations. In the case of the plane tail section the difference between the actual site and 1991 FBD GPS reported location was 1500 m, and, according to the FBD longitude and latitude fix of the 150+ barrel site it is located up on dry land at the Initial Attack Base, not in the lake, see Photograph No. 2.

In addition to these differences, the process of locating individual barrels by their longitude and latitude (GPS) would require a significant amount of time and invariably delay the project well into the ice cover period. As a result, FTI personnel resurveyed the 1991 FBD barrel positions by travelling the perimeter of the lake in a boat and estimating their position using the map supplied in the 1991 FBD survey. This method in itself was difficult as the actual shoreline contours and that shown on the FBD map often did not coincide.

Once in the area where barrels were indicated on the FBD map, FTI personnel performed a grid search in the boat until the barrel(s) were spotted from the surface. A marker buoy was then deployed so that the recovery team could return to the site to salvage the barrel(s).

This process worked well on calm days, however, on windy days the surface waves limited the depth to which the search team could view the bottom. In addition, the wave action would stir up the fine sediments on the shallow lake bottom further reducing the visibility.

During the search for the barrels identified by the 1991 FBD survey, extra barrels were observed. Although not part of the scope of this contract, FTI personnel spent one full day performing a cursory survey of approximately 70% of the lakeshore and made notes on the locations of the extra barrels. The shallow sections of the lake that were not surveyed by the FTI crew included the southern shoreline between FTI Sites 35 and 48 on Drawing No. 2, the area surrounding the island, and, the shoals located in the central portions of the lake.

Initial Attack Base Barrel Recovery Procedure

The first step in the procedure was the deployment of marker buoys indicating the approximate length and width of the Initial Attack Base barrel dump site. Next, a 33 m by 1 m spill boom was deployed in order to encompass a section of shoreline where the greatest water depth or steepest sub-surface slope was located, see Photograph No. 3. Each end of the spill boom was fixed onshore with steel pipes hammered into the ground while the outer perimeter of the boom was held in place with a series of offshore anchors.

A ground sheet of polyethylene plastic was laid down upland of the spill boom where the barrels were brought ashore and temporarily stored, see Photograph No. 4. The polyethylene sheets were placed so that any leakage from the barrels would drain down to a single point where it could be captured.

A dive survey of the barrels was conducted to determine their condition, see Photograph No. 5. Those barrels that were severely corroded and did not appear to contain any significant amounts of contaminants were recovered first. By recovering the most heavily damaged barrels first, clues as to the actual contents of the barrels could be gathered with the lowest risk of a contaminant release.

Two 22 litre buckets, attached to a lifting strap, were used to raise the barrels off the bottom in an upright position, see Photograph No. 6. While suspended in the water column the barrels were inspected for leakage and structural integrity, see Photograph No. 7. The barrels were then floated through the water column to inside the spill boom where the lift buckets were disconnected, see Photograph Nos. 8, 9 and 10.

The barrels were rolled/lifted up a ramp onto the plastic ground sheets. Any liquids leaking from the barrels while on the plastic sheets were evaluated for the physical presence of contaminants. If contaminants were present then absorbent pads were laid down and the spilled material collected. Once on land the barrels were further inspected for integrity, markings and the presence of contaminants. They were later transported to the DIAND storage site.

Lakeshore Barrel Recovery Procedure

Depending on their condition and location, the barrels located around the lakeshore were recovered using a variety of methods. Despite changes in the recovery methodology, the same barrel evaluation procedures as those used at the Initial Attack Base were employed.

Most of the lakeshore barrels were floated to the surface using lift buckets as well as filling the barrels themselves with air. Once on the surface they were lifted manually up onto the recovery barge, boat or directly up onto the adjacent shoreline. Those barrels that were filled with stones or sand were emptied prior to their recovery. Other barrels, that were sunk in the lake bottom, had to be broken free from the suction of the bottom by pulling on them with the boat, com-a-longs or jetting air into the mudline around the barrel. All of the lakeshore barrels were stored upland at key locations where road access permitted their retrieval by truck.

Transport and Storage

All barrels were transported to the specified DIAND storage site southeast of the airport using a pick-up truck and/or a trailer, see Photograph No. 11. None of the barrels leaked any significant amount of contaminants during their transport to the storage site.

A concrete pad at the DIAND site was chosen as a suitable storage area as it would form a physical barrier between the barrels and the underlying soil. In addition, a plastic sheet was laid over the concrete pad prior to storage of the barrels in order to ensure that leaked contaminants did not pass through any cracks in the concrete and into the ground, see Photograph No. 12. In order to prevent rain creating a leachate from the barrels, plastic sheets were laid over top of the stored barrels, see Photograph Nos. 13 and 14.

RESULTS

General

The project was started on September 18th with the mobilization of equipment and manpower to Watson Lake. Much of the equipment including the spill boom were shipped by truck the previous week. As per the proposal, the field work was completed on September 30th, 1994.

The actual procedures employed during the project were largely identical to those put forward in the proposal. This similarity between the actual and proposed procedures was due in part to the successful integration of local experience with FTI's technical and project management expertise.

Initial Attack Base Barrels

The condition of the barrels ranged from being corroded in half to having a few holes (2 mm in diameter). Typically, the holes were located at random over the barrel surfaces that were not buried in the lake bottom. However, in some cases the holes were concentrated on the ribs of the barrels.

The most common contaminant identified was a tar-like substance located in the bottom or adhering to the sides of some barrels. The amount of contaminant in any one barrel appeared to be less than one litre. One barrel was recovered that contained a small amount of 100 weight oil, see Photograph Nos. 15 and 16. One other barrel appeared to contain a small amount of diesel fuel. In both of these cases there was little residue left in the barrels and any spilled material was successfully collected using absorbent pads.

Barrels that had only small holes were brought upland and allowed to drain. None of the lake water that drained from these barrels contained any physical evidence of contaminants. After a period of time the barrels that had holes located around their bases would begin to ooze the residual tar-like substance, see Photograph No. 17. This oozing took place despite air temperatures of less than ten degrees Celsius.

Lakeshore Barrels

These barrels were often buckled or crushed and many of them contained sand, gravel or rocks. Although no significant amounts of contaminants were found in these barrels, evidence that these barrels contained a tar-like residue in the past was observed.

The single barrel located near the island in the centre of the lake was severely corroded and appeared to contain the same tar-like residue identified in the barrels recovered offshore of the Initial Attack Base.

FTI 1994 Cursory Survey

The results of the FTI cursory visual survey of the lakeshore identified 142 barrels (of which 11 barrels were recovered) in addition to the 73 barrels identified in the 1991 FBD survey, see Table 1. The FTI survey covered approximately 70% of the lakeshore for distances of up to 10 m offshore. The section of the lake that was not surveyed included the shallows located greater than 10 m offshore, the area surrounding the island, and, the southern shore located between FTI Sites 35 and 48 shown on Drawing No. 2.

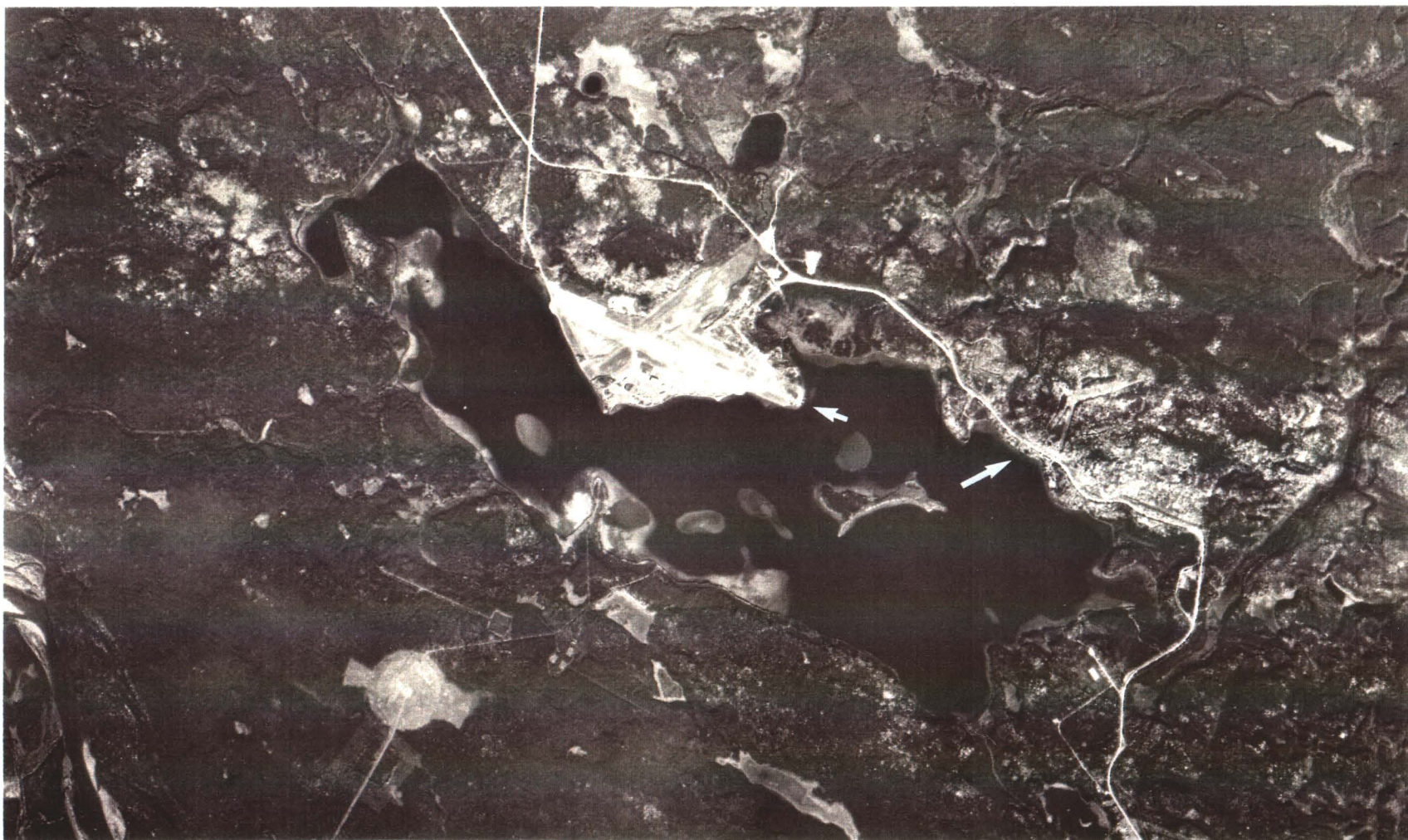
DISCUSSION AND RECOMMENDATIONS

Although this project was completed on time and on budget, the delays caused by the inaccuracies associated with the 1991 FBD survey data could have had a much greater negative impact on the project's success. If the barrels had not been visible from the surface, as a result of turbid water or because of ice cover, there would have been no way to relocate the barrels for recovery. If future recovery programs are to be successful, then accurate reproducible survey data is mandatory. In addition, the form of that data should take into account the methods that may be required to perform the recovery. In the case of Watson Lake, where all the barrels identified for recovery were located along the lakeshore, it would have been beneficial to have local geographical, physical or biological features to relocate the position of the barrels.

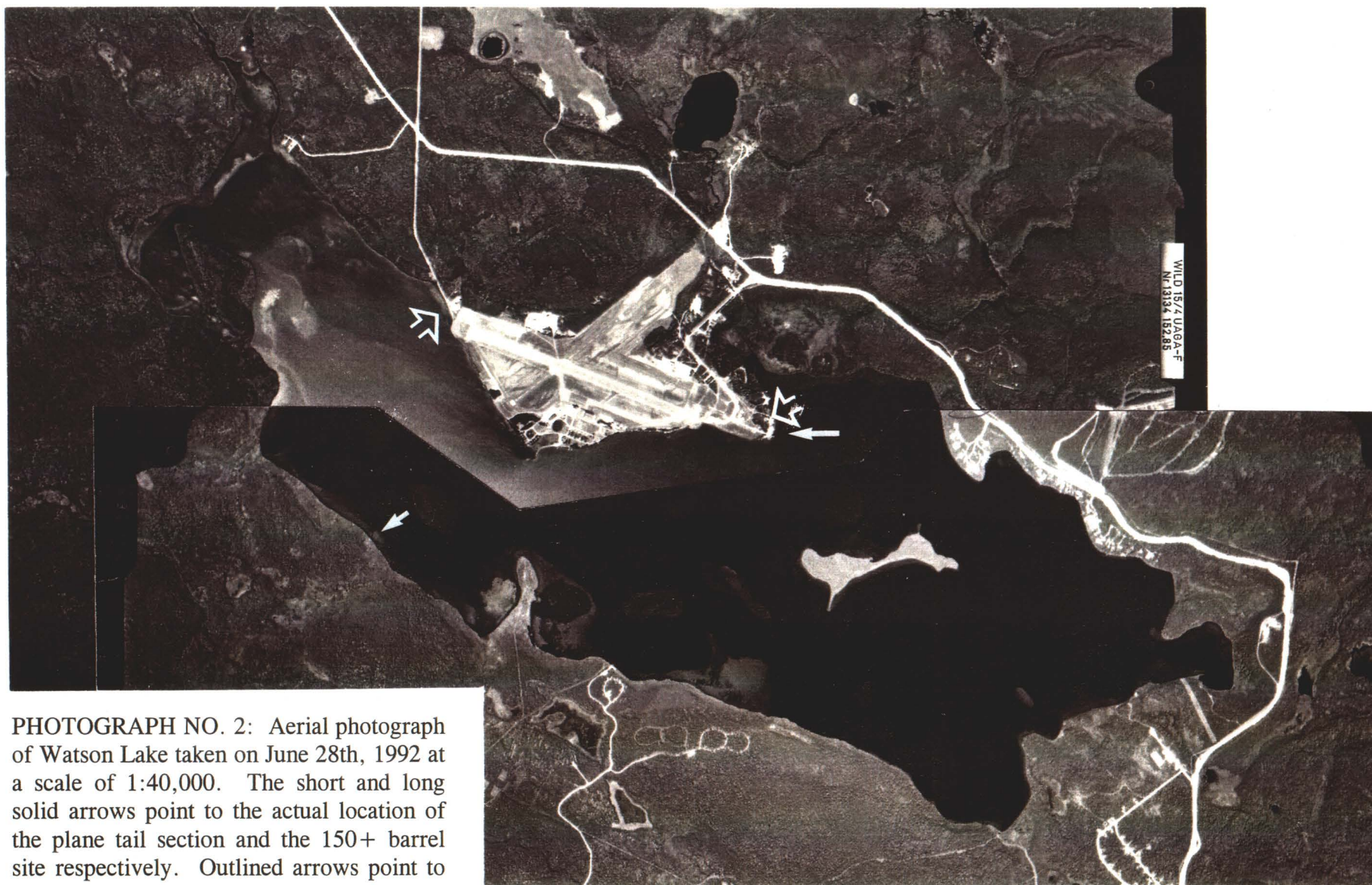
The similarity of the lakeshore barrels with those located at the Initial Attack Base, in terms of their condition and residual contents, suggests that many of these barrels were dumped into the lake during the same period, circa 1940s, 50s and 60s. This evidence together with the significant number (142) of extra barrels found and their distribution indicate a high probability that additional barrels or debris exists in the deeper sections of the lake. In addition, if the Initial Attack Base barrels were an example of a deliberate dump site set up during the winter so that the barrels would sink through the ice during the spring melt, then it is reasonable to expect that other dump sites would have been set up on the ice over deeper sections in the lake. In this way, the debris would not be visible from the surface, a practice that would have been preferred. As a result, further investigation into the existence of debris in Watson Lake is warranted.

Although the unrecovered extra lakeshore barrels appear to pose no environmental threat, in so far as they are likely to contain similar types and amounts of contaminants, there is no way to determine the environmental threat any one barrel may represent until it is recovered. Therefore, any future recovery projects must treat each barrel accordingly and ensure that appropriate spill response precautions and procedures are in place.

The success of this project has demonstrated that government, private industry and local residents can be combined to perform environmental recovery projects. This project has also been successful in demonstrating some environmental recovery procedures to the residents of Watson Lake. Although it would be premature to expect local residents to assume complete responsibility for recovering unknown substances from Watson Lake, with some project management assistance the bulk of any recovery work in Watson Lake could be performed locally.



PHOTOGRAPH NO.1: Aerial photograph of Watson Lake taken on September 18th, 1980 at a scale of 1:50,000. Note the location of the airport on the north shore of the lake and the small island in the southeastern section of the lake. Also note the residences along the northeastern shore (longer arrow) and the location of the B.C. Forest Service's Initial Attack Base (shorter arrow).



PHOTOGRAPH NO. 2: Aerial photograph of Watson Lake taken on June 28th, 1992 at a scale of 1:40,000. The short and long solid arrows point to the actual location of the plane tail section and the 150+ barrel site respectively. Outlined arrows point to the approximate longitude and latitude positions given in the 1991 FBD survey.



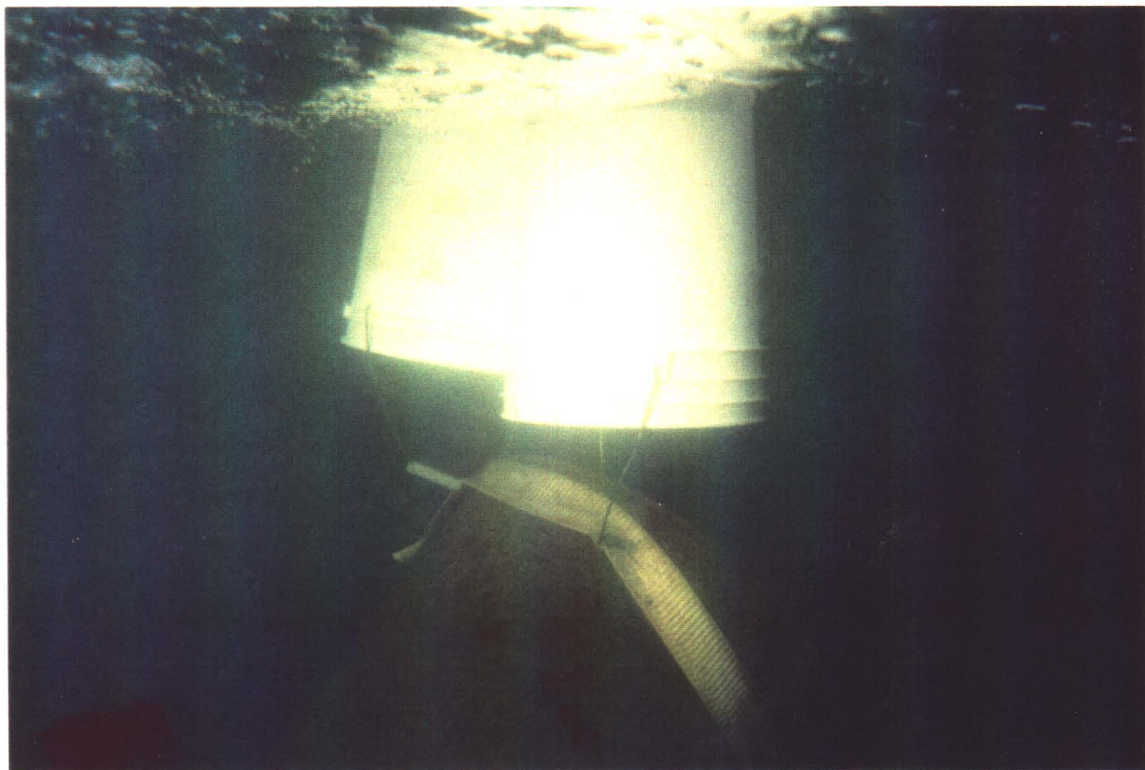
PHOTOGRAPH NO. 3: Deployed spill boom adjacent to the shoreline at the Initial Attack Base, Watson Lake. Note barrels stacked for transportation to the DIAND storage site.



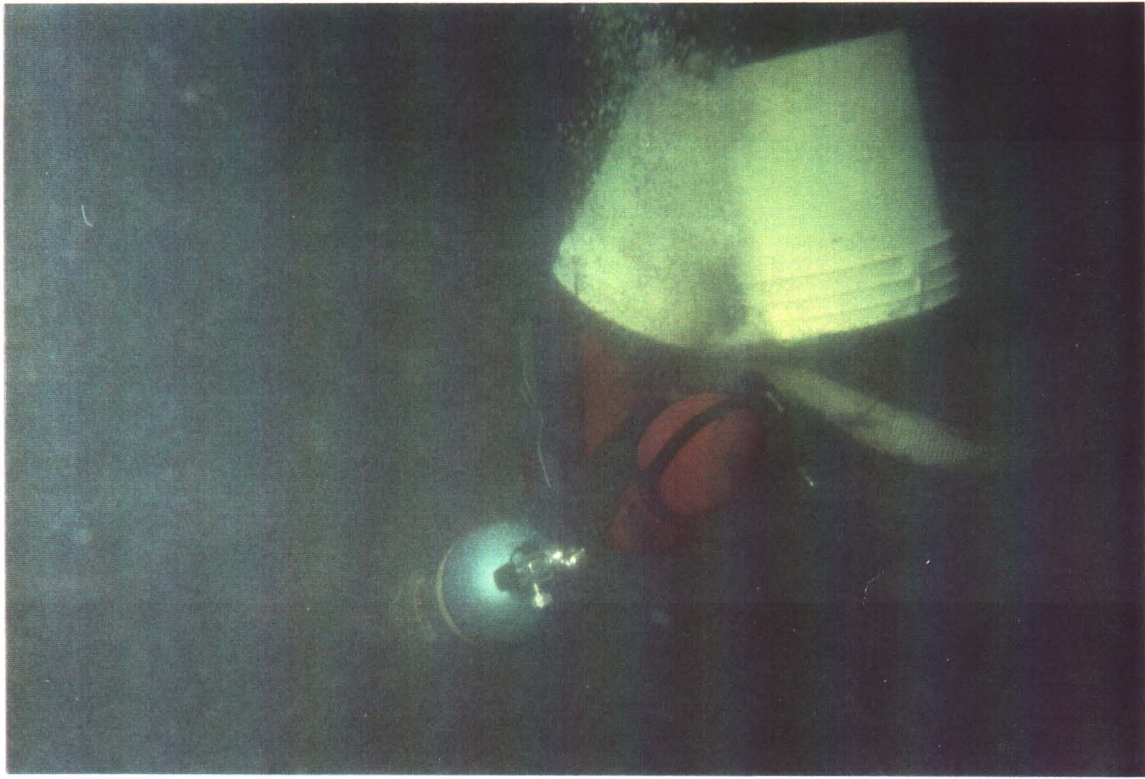
PHOTOGRAPH NO. 4: Recovered barrels at the Initial Attack Base. Note plastic ground sheet and half corroded barrel (arrow).



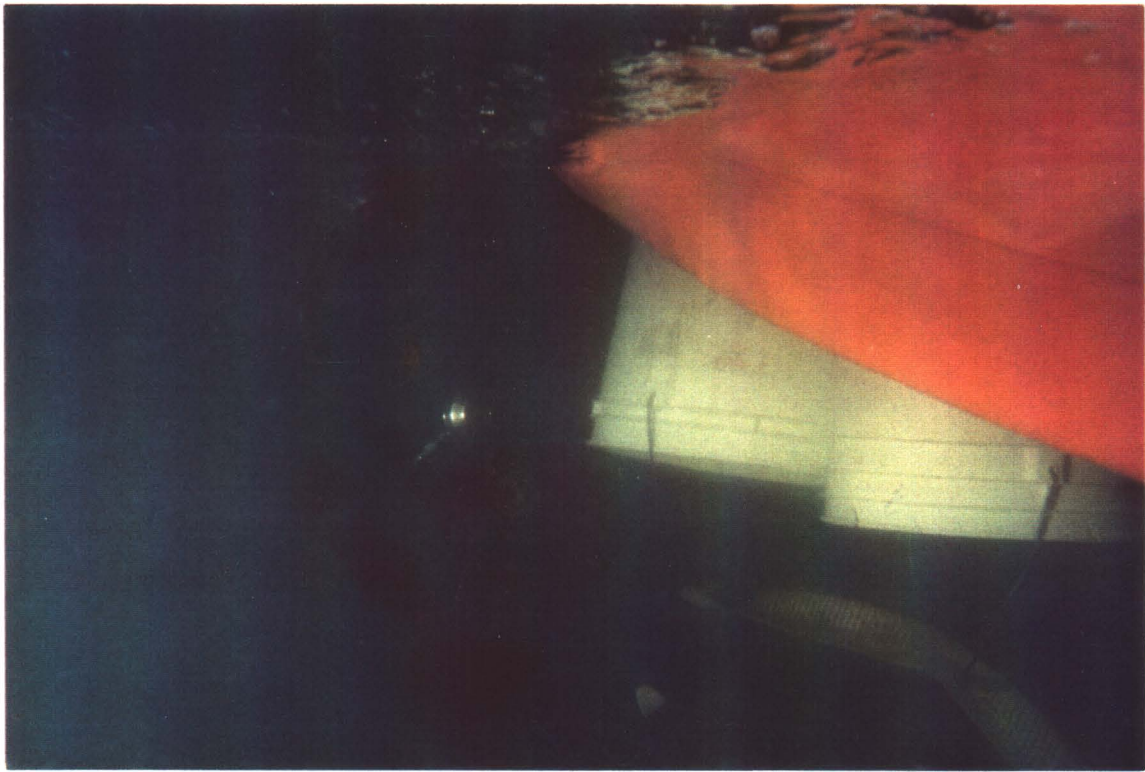
PHOTOGRAPH NO. 5: Unrecovered barrels at the Initial Attack Base site.



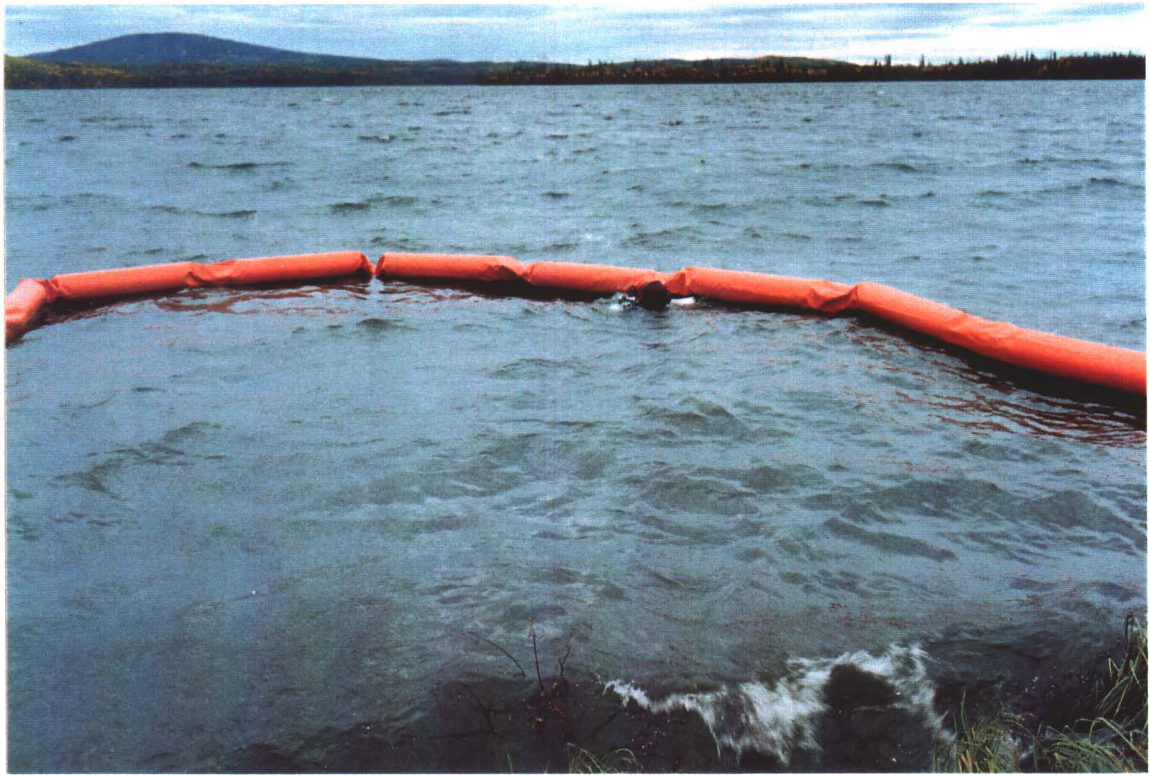
PHOTOGRAPH NO. 6: Two 22 litre buckets and a lifting strap being used to raise a barrel to the surface.



PHOTOGRAPH NO. 7: Barrel suspended in the water column being inspected by diver for leaks and pre-transport integrity.



PHOTOGRAPH NO. 8: Diver bringing suspended barrels under spill boom.



PHOTOGRAPH NO. 9: Diver delivering suspended barrel inside spill boom.



PHOTOGRAPH NO. 10: Diver disconnecting lift buckets inside spill boom prior to barrel removal from water. Note ramp used to roll/lift barrels out of the water up onto the plastic ground sheet.



PHOTOGRAPH NO. 11: Barrels being loaded onto pick-up truck and trailer for transportation to the DIAND storage site at the airport.



PHOTOGRAPH NO. 12: DIAND storage site. Note plastic ground sheet laid on top of concrete pad.



PHOTOGRAPH NO. 13: Plastic sheet being laid over top of stacked barrels. Note poor condition of some of the barrels (arrows).



PHOTOGRAPH NO. 14: Barrel storage completed and ready for transport to be recycled or destroyed.



PHOTOGRAPH NO. 15: Markings on one of the barrels recovered from the Initial Attack Base indicating that the barrel once contained 100 weight oil.



PHOTOGRAPH NO. 16: Oil residue from the barrel identified in Photograph No. 15. Spilled contaminants were recovered using oil absorbing pads and transported along with the barrels to the DIAND storage site.



PHOTOGRAPH NO. 17: Black shiny tar-like residue typical of most barrels recovered at the Initial Attack Base. Note higher levels of corrosion damage on the raised rib of the barrel.

TABLE 1

**LOCATION AND NUMBER OF EXTRA BARRELS IDENTIFIED
DURING THE FTI CURSORY VISUAL INSPECTION OF
WATSON LAKE, YUKON TERRITORY**

Site No.	No. of Barrels	Barrel Condition or Description
1	5	Underwater, sandfilled or under old dock debris
2	6	Shoreline, sandfilled
3	1	Underwater, sandfilled
4	6	FBD Site (12 barrels removed as per contract), 6 extra sand filled barrels remain
5	7	FBD Sites (5, 4 and 4 barrels removed as per contract), 7 extra shoreline sandfilled barrels remain
6	10	Underwater, scattered between FTI Site No. 5 and float
7	3	Underwater
8	2	Underwater, 1 barrel is 2/3s buried, sandfilled, beside dock in lagoon / 1 barrel is resting on bottom 20' offshore @ mouth of lagoon
9	9	Underwater between point and blue plastic float
10	1	Underwater, resting on mud, 30' offshore
11	1	Underwater, resting on mud, 30' offshore
12	2	Underwater, resting on mud, 15' & 20' offshore, 20' between barrels
13	2	Underwater, barrels resting on mud 5' & 10' offshore
14	2	Underwater, 1 barrel is 1/4 buried & 5' offshore / 1 is resting on mud
15	1	Underwater, 2/3 buried, 15' offshore
16	1	Shoreline, 1/3 buried, 15' offshore
17	1	Shoreline, resting on mud
18	2	Underwater, shallow soupy bottom, 1 barrel is 1/2 buried & broken / 1 barrel resting on mud
19	1	Shoreline, 1/3 buried
20	1	Shoreline, floating
21	1	Underwater, 2/3 buried, 40' offshore
22	1	Underwater, 3/4 buried, shoreline
23	1	Shoreline, resting on mud
24	1	Underwater, broken up, 15' offshore
25	2	Underwater, 2/3 buried, 1 barrel is on shoreline and 1 barrel is 15' offshore
26	1	Shoreline, very heavy
27	21	Underwater, spread out 50' on either side of plane fusilage
28	1	Underwater, resting on mud, 30' offshore
29	1	Underwater, resting on mud, 15' offshore
30	1	Underwater, resting on mud, 25' offshore
31	1	Underwater, 2/3 buried, 10' offshore
32	1	Shoreline, floating
33	1	Shoreline, floating
34	1	Underwater, broken up, shoreline
35	1	Underwater, flattened, 20' offshore
36	2	Underwater, 1/2 buried, 3' offshore, cabled together, heavy

TABLE 1 continued

LOCATION AND NUMBER OF EXTRA BARRELS IDENTIFIED
DURING THE FTI CURSORY VISUAL INSPECTION OF
WATSON LAKE, YUKON TERRITORY

Site No.	No. of Barrels	Barrel Condition or Description
37	1	Shoreline, 1/4 above water, shallow soupy bottom
38	2	1 barrel floating on shoreline / 1 barrel underwater & 3/4 buried
39	2	1 barrel sandfilled 20' offshore / 1 barrel floating on shoreline
40	1	Underwater, 20' offshore
41	1	Shoreline, 2/3 buried, sand filled
42	3	FBD Site (5 barrels removed as per contract), 3 extra barrels remain
43	6	FBD Site (10 barrels removed as per contract), 6 extra barrels remain – 2 are 30' offshore and 4 are along the shoreline & rock filled
44	1	FBD Site (1 barrel removed as per contract), 1 extra barrel remains
45	6	Shoreline, rockfilled
46	3	FBD Site (5 barrels removed as per contract), 3 plus barrels remain
47	1	Shoreline, intact & heavy
48	2	Underwater, > 30' offshore, 2 plus barrels identified
	131	TOTAL NUMBER OF EXTRA BARRELS FOUND BY FTI
<p>Notes: – Eleven (11) extra barrels, not included in the above list, were recovered by FTI bringing the total number of extra barrels actually found to 142. – The FTI survey of Watson Lake was a cursory visual inspection and as a result it is highly probable that additional extra barrels remain in the lake.</p>		



APPENDIX I

PROJECT EQUIPMENT

Following is a list of the primary equipment used during the recovery of barrels from Watson Lake.

Spill Containment and Storage Materials

- 33 m of 1 m spill boom
- oil absorbent pads
- polyethylene bagging and catchment materials
- spill containment drums
- stretch wrap

Diving and Recovery Equipment

- SCUBA tanks
- drysuits
- regulators
- underwater Nikonos camera and strobe
- lift buckets and slinging gear
- low pressure air compressor
- 60 m of air hose

Support Equipment

- 7 m dive boat
- barge
- Hyab equipped truck
- van
- pick-up truck and trailer